Management Measure 11
Operation and Maintenance

A. Management Measure

Develop a program for regular inspection and prompt repair or replacement of urban runoff management practices.

- Establish a program to conduct inspections and perform maintenance on runoff management practices.
- Maintain transportation and storm drain infrastructure to reduce loads at their source.
- Inspect, maintain, and repair runoff treatment controls to maintain design treatment capacity.
- Inspect, maintain, and restore aquatic buffers.

B. Management Measure Description and Selection

1. Description

Regular inspection and monitoring are essential to maintain performance objectives of storm water management facilities. Measuring the performance of each facility after large storms provides a baseline against which to compare future performance. Maintenance checklists facilitate inspections by promoting thoroughness and consistency among inspectors, in addition to providing a historical record of maintenance and reducing the potential for future liability. This record of inspections and maintenance is also useful in justifying funding by documenting problems that require attention.

Several general maintenance activities should be conducted for runoff management practices: vegetation management, sediment removal, and protection against erosion. First, where appropriate, facilities should be maintained for optimal vegetation. Too little vegetation, or the wrong type of vegetation, can promote high runoff velocity and erosion, as well as poor infiltration and pollutant removal capacity. Too much vegetation might result in decay and release of nutrients. Additionally, vegetation that is too dense can impede the flow of water and result in near-imperviousness.

Second, runoff management practices are subject to clogging from sediments. Both coarse and fine particles can reduce the effectiveness of the facility. The particles can cause sealing of soil pore spaces, which prevents infiltration and results in standing water. Inlets or outlets can become blocked with sediment over time, causing overflow of runoff into areas not designed to receive this type of flow. Also, when sediments build up in ponds, the retention capacity of the ponds is decreased and high peak flows downstream can result.

Finally, erosion from contributing drainage areas exacerbates sedimentation problems. Stabilizing areas surrounding the site by using vegetation or other erosion control methods can greatly reduce the frequency of required maintenance, thereby reducing maintenance costs. The following section discusses specific operation and maintenance (O&M) requirements for several types of runoff management practices.

When maintenance considerations are incorporated into management practice designs, subsequent maintenance costs and repairs are often lower. The removal of sediment, for example, can be less expensive if sediment traps are designed for easy cleaning and provide adequate access for the intended equipment. Safe and convenient access to outlet structures for repairs or to remove blockages can also reduce maintenance costs and prevent nuisance flooding. Proper construction techniques, particularly for infiltration management practices, can also reduce the frequency of maintenance or repairs.

2. Management Measure Selection

Improper O&M can result in increased discharge of pollutants to downstream waters, increased risk of flooding, and increased channel instability downstream. Life and property might be at a greater risk when runoff systems are poorly maintained. Therefore, standards should be devised for maintenance of runoff controls and an inspection schedule should be created to determine what maintenance or improvements are needed. Inspection frequency depends on the local climate and precipitation and the type of runoff management system.

Effective programs need to identify the governmental or other functional department(s) responsible for the maintenance program. Because maintenance issues are critical to successful program implementation, they should be planned for at the outset of the runoff management program and maintenance activities should be conducted continuously throughout program implementation.

Implementing the practices described under this management measure will facilitate the development of an effective O&M program for continued effectiveness and longevity of runoff management practices.

C. Management Practices

1. Establishing an Operation and Maintenance Program

The expense of maintaining most structural management practices is relatively small compared to the original construction cost. Too frequently, however, maintenance is not completed, particularly when the practice is privately owned. The following section outlines several practices that will facilitate development of a runoff control O&M program.

a. Establish a runoff control operation and maintenance ordinance

One way for local governments to ensure that maintenance of runoff control facilities is performed is to establish an ordinance that mandates these activities. The O&M language in a runoff control ordinance can specify that runoff management practices must be designed to facilitate easy maintenance and require that regular maintenance activities are completed.

EPA (2000) has provided model ordinance language on its web site (*www.epa.gov/nps/ordinance*) that includes consideration of maintenance of runoff control management practices. Examples from across the country are provided, including ordinance language, an example maintenance agreement, an easement and right-of-way agreement, an inspection checklist, and a performance bond.

It is important for O&M ordinances to identify a specific entity responsible for long-term maintenance and to require regular inspection visits. The ordinance also should address design guidelines that can help ease the maintenance burden, such as the inclusion of maintenance easements. Note that runoff control ordinance language regarding the maintenance of erosion and sediment control practices differs from language regarding maintenance of postconstruction controls because of the short-term nature of the erosion and sediment control practices.

b. Make provisions for maintenance in the design and construction of management practices

Because maintenance programs play such an important role in ensuring the proper operation of most structural practices and some source controls, emphasis should be given to maintenance issues when identifying management practices under any runoff management program. Making provisions for maintenance at the design and construction phase involves identifying the urban runoff practices to be used when designing a new facility. Practices should be designed for easy access for maintenance equipment (mowers and vactor trucks). Also, many practices have been designed with inadequate pretreatment (without a sediment basin at the inlet). Finally, inlet and outlet structures tend to clog easily. Adequate size and storage volume based on expected sediment loads from the contributing drainage area is required in the design of inlets and pretreatment structures.

c. Identify mechanisms for program funding

It is important to identify the entity responsible for operating and maintaining structural runoff control practices. The responsible party can be a property owner, homeowners' association, or local government agency. In many cases local governments assume the responsibility of maintaining privately owned facilities because private entities have proven to be lax in fulfilling their maintenance responsibilities; if the facilities fail, then the burden of downstream restoration will ultimately fall under the local government's responsibility anyway. Public financing for maintenance of both public and private facilities can come from general tax revenues, storm water utility fees, inspection or permit fees, or dedicated contributions. A discussion of these and other financing options for maintenance of runoff control facilities is provided in Chapter 8 of the Watershed Management Institute's (1997) *Operation, Maintenance, and Management of Stormwater Management Systems*.

It is important that the funding source for maintenance of runoff control facilities is supported by the public. The Watershed Management Institute (1997) stresses the importance of public education to inform citizens about the locations and functions of runoff control facilities and the importance of performing regular maintenance. They reason that citizens and government officials will be more willing to allocate funds to projects that they know will provide tangible benefits to the community. WMI also recommends that funding programs for maintenance activities

- Be based on a stable source of consistent funds that will ensure a long-term commitment of personnel, equipment, and materials.
- Be compatible with the local organizational structure to allow use of existing billing, collection, and bookkeeping operations.
- Include provisions for four essential operations: (1) program administration, (2) accounting and budgeting, (3) revenue management, and (4) information management.
- Be based on an equitable, understandable, and defensible fee or rate structure.
- Be continually reviewed and updated to meet the changing maintenance needs of the runoff control program.
- Be consistent with applicable state laws and regulations.

d. Plan regular inspections

Inspections are essential to successful operation of the facility. They require necessary equipment, proper attitudes, appropriate training, and suitable inspection procedures. An inspection schedule and checklist should be developed and adhered to.

e. Schedule maintenance, cleaning, and debris removal to avoid sediment accumulation

Sediment and debris can contain hazardous contaminants and can clog filtration and infiltration practices, which will reduce their effectiveness over time. Maintenance programs should include measures for cleaning catch basins and drainage channels in addition to major structural controls. Establishment of an effective O&M program should include creating maintenance logs and identifying specific maintenance triggers for each class of control (e.g., removing sediment from forebays every year and retention ponds every 5 years, cleaning catch basins at least annually prior to the rainy season, removing litter from channels twice a year). If maintenance activities are scheduled infrequently, regular inspections should be made to ensure that the control is operating adequately.

f. Make provisions for monitoring of treatment criteria

Regular monitoring of the influent to and effluent from structural management practices will support program goals by facilitating the development of a database from which future decisions can be made about the performance of selected practices for various applications. Also, these data will make it easier to quantify the performance of the practice and determine its response to regular maintenance.

g. Implement training certification programs and provide educational opportunities for management practice operators

Training and certification programs are gaining popularity around the country at both the state and local levels. Municipalities sometimes use contractors to conduct inspections and maintenance because resources are not available to purchase equipment and fund staff dedicated to these activities. Good training programs can ensure that inspections and maintenance activities are carried out in a thorough and consistent manner. Also, training programs can be customized to address local concerns and conditions such as high flows, highly erodible soils, or invasive species.

2. Source Control Operation and Maintenance

a. Infrastructure

(1) *Street sweeping*. Street cleaning reduces pollutants carried in runoff from street surfaces. The frequency of cleanings should reflect the rate of pollutant buildup and should increase just before the rainy season. An effective street sweeping program requires that it be conducted on a regular basis. Sweeper operators require training, and equipment needs to be maintained regularly to ensure that sweepers are functioning as designed. Finally, parking restrictions can be implemented to guarantee adequate cleaning despite on-street parking. Table 8.1 shows O&M costs associated with street sweeping. Also see Management Measure 9: Pollution Prevention for more information about street sweeping in the context of trash removal.

Table 8.1: Street sweeper O&M costs (adapted from CWP, 1998).

Maintenance Considerations		Sweeper Type	
		Mechanical Sweeper	**Vacuum-assisted Sweeper**
O&M costs (1998 dollars)	Cost ($/curb mile)	30	15
	Weekly sweeping ($)	1,680	946
	Biweekly sweeping ($)	840	473
	Monthly sweeping ($)	388	218
	4 times per year sweeping ($)	129	73
	Twice per year sweeping ($)	65	36
	Annual sweeping ($)	32	18
Expected life (years)		5	8

(2) *Storm drain flushing*. This practice removes deposited materials from storm drain pipes to maintain the design flow capacity. The flushing schedule should be designed to prevent excessive buildup based on estimated inputs from the contributing drainage areas, cleaning history, and visual inspections. Flushing is performed either at or upstream from problem areas. There are costs to consider for collecting and disposing of sediments, debris, and flush water, in addition to costs for supplying flush water, collecting sediment, and treating sediment-laden water if the storm drains are being flushed to a receiving waterbody.

(3) *Catch basin cleaning*. Cleaning catch basins removes excess pollutants, thereby reducing high pollutant concentrations in a storm's first flush, preventing clogging, and restoring sediment-trapping capacity. Maintenance should be targeted to areas with the greatest pollutant loading and to areas near sensitive waterbodies. A maintenance log should be maintained to track progress. If there are many catch basins in a community, mechanical cleaners (vactors, vacuums, or bucket loaders) might be required; otherwise, hand cleaning will suffice. Proper recordkeeping, waste disposal, and safety procedures are essential for a successful program.

(4) *Highway, bridge, and road maintenance*. Maintenance of roads and bridges can be a significant source of pollutants. Some methods to prevent materials from contaminating runoff are limiting salting; using suspended tarps, vacuums, or booms to reduce pollutant drift onto waters from scraping and painting; and training road crews in proper waste control and disposal methods. Treatment controls also can be used on-site to reduce the amount of polluted runoff that enters receiving waters. Runoff reduction, conveyance, and treatment practices (e.g., infiltration swales in median strips) can be incorporated into the design of new roadways and bridges, which will help contain pollutants from traffic as well as from maintenance activities. (Also see Management Measure 7: Bridges and Highways.)

b. Trash in channels and creeks

Cleanup of trash from streams and storm water conveyance infrastructure can reduce pollutant levels in downstream waters. Areas where dumping occurs frequently can be identified and inspected regularly, and “no littering” or “no dumping” signs can be posted to deter future dumping. Steep fines for dumping might also discourage potential transgressors. Costs for these practices are associated with the purchase of signs and equipment, personnel to conduct inspections and cleanup, and landfill space to dispose of recovered items. Cost savings also can be achieved through community or volunteer cleanup programs.

3. Treatment Control Operation and Maintenance

Runoff treatment controls require periodic inspection and maintenance to ensure that sediment, trash, and overgrown vegetation are not impeding the performance of such devices. Regular inspections should be performed along with routine maintenance. Nonroutine maintenance may be required to repair structures, control erosion, and remove unwanted vegetation. Table 8.2 and the following practices describe maintenance costs, activities, and schedules for several categories of urban runoff treatment practices.

a. Ponds and wetlands

Extended dry detention ponds are submerged only during storms and are dry between storm events. They require mowing at least once a month to maintain turf grass cover, or once a year to prevent the establishment of woody vegetation. Sediments should be removed when they are dry and cracked to separate them from vegetation more easily. Pilot or low-flow channels require inspection to prevent undermining of concrete channels and overgrowth of stone channels. Inlets and outlets should be cleared of sediment and debris to prevent clogging.

Wet ponds are susceptible to algae blooms as a result of high nitrogen levels and might need to be cleaned periodically. Sediments that accumulate in the pond inlet or forebay should be removed more frequently than fine sediment, which collects near the pond outlet. In general, sediments should be cleared every 10 to 20 years. Sediment removal involves draining the pond (leaving some water to maintain the fish population) and removing the sediments for drying. Pond water should be disposed of in an approved manner; it should be tested for pollutants and released to the receiving water, if allowed, or pumped and hauled to a disposal facility. While the stockpiled materials are drying, erosion controls should be implemented to prevent sediment loss. All structures and surrounding areas should be inspected for leakage, seepage, corrosion, and wear and tear. Inspectors and crews should pay special attention to structural integrity to ensure that ponds operate safely.

Constructed wetlands should be inspected approximately four times per year to determine if they are retaining and discharging storm water at an appropriate rate and whether maintenance is needed. Constructed wetlands require periodic cropping, removal of trash and nuisance or woody vegetation, repair of animal burrows in embankments, and clearing of inlets and outlets. Side slopes should be stabilized with vegetative cover to prevent erosion. Wetland plants should be thinned and transplanted as necessary to maintain adequate cover throughout the wetland. In general, semiannual sediment removal is recommended to ensure that treatment capacity is maintained. Mosquitoes might be a problem in some areas, and introducing natural predators such as mosquito fish (*Gambusia*) can control them effectively. Consultation with a wetland scientist is recommended to ensure that the constructed wetland functions as intended.

Table 8.2: Maintenance costs, activities, and schedules for runoff control practices in 1998 dollars (Adapted from CWP, 1998).

Category	Management Practice	Annual Maintenance Cost (% of Construction Cost)	Maintenance Cost for a "Typical" Application	Maintenance Activity	Schedule
Detention ponds or vaults	Dry ponds	~1%	$1,200	– Cleaning and removal of debris after major storm events (>2" rainfall) – Harvest vegetation when a 50% reduction in the original open water surface area occurs – Repair of embankment and side slopes – Repair of control structure	Annual or as needed
				– Removal of accumulated sediment from forebays or sediment storage areas when 60% of the original volume has been lost	5-year cycle
				– Removal of accumulated sediment from main cells of pond once 50% of the original volume has been lost	20-year cycle

Table 8.2 (continued).

Category	Management Practice	Annual Maintenance Cost (% of Construction Cost)	Maintenance Cost for a "Typical" Application	Maintenance Activity	Schedule
Ponds	Extended detention ponds, wet ponds, multiple pond systems, "pocket" ponds	3%–6%	$3,000–$6,000	– Cleaning and removal of debris after major storm events (>2" rainfall) – Harvest vegetation when a 50% reduction in the original open water surface area occurs – Repair of embankment and side slopes – Repair of control structure	Annual or as needed
				– Removal of accumulated sediment from forebays or sediment storage areas when 60% of the original volume has been lost	5-year cycle
				– Removal of accumulated sediment from main cells of pond once 50% of the original volume has been lost	20-year cycle
Wetlands	Shallow wetlands, pond wetlands, "pocket" wetlands	~2%	$3,800	– Cleaning and removal of debris after major storm events (>2" rainfall) – Harvest vegetation when a 50% reduction in the original open water surface area occurs – Repair of embankment and side slopes – Repair of control structure	Annual or as needed
				– Removal of accumulated sediment from forebays or sediment storage areas when 60% of the original volume has been lost	5-year cycle
				– Removal of accumulated sediment from main cells of pond once 50% of the original volume has been lost	20-year cycle

Table 8.2 (continued).

Category	Management Practice	Annual Maintenance Cost (% of Construction Cost)	Maintenance Cost for a "Typical" Application	Maintenance Activity	Schedule
Infiltration practices	Infiltration trench	5%–20%	$2,300–$9,000	– Removal of accumulated sediment from forebays or sediment storage areas when 60% of the original volume has been lost	5-year cycle
				– Removal of accumulated sediment from main cells of pond once 50% of the original volume has been lost	20-year cycle
	Infiltration basin	1%–3%	$150–$450	– Cleaning and removal of debris after major storm events; (>2" rainfall) – Mowing and maintenance of upland vegetated areas – Sediment cleanout	Annual or as needed
		5%–10%	$750–$1,500	– Removal of accumulated sediment from forebays or sediment storage areas when 50% of the original volume has been reduced	3- to 5-year cycle
Filtration practices	Sand filters	11%–13%	$2,200	– Removal of trash and debris from control openings – Repair of leaks from the sedimentation chamber or deterioration of structural components – Removal of the top few inches of sand, and cultivation of the surface, when filter bed is clogged	Annual or as needed
				– Clean out of accumulated sediment from filter bed chamber once depth exceeds approximately ½ inch, or when the filter layer will no longer draw down within 24 hours – Clean-out of accumulated sediment from sedimentation chamber once depth exceeds 12 inches	3- to 5-year cycle

Table 8.2 (continued).

Category	Management Practice	Annual Maintenance Cost (% of Construction Cost)	Maintenance Cost for a "Typical" Application	Maintenance Activity	Schedule
Filtration practices (continued)	Bioretention	5%–7%	$3,000–$4,000	– Repair of erosion areas – Mulching of void areas – Removal and replacement of all dead and diseased vegetation – Watering of plant material	Biannual or as needed
				– Removal of mulch and application of a new layer	Annual
	Filter strips	$320/acre (maintained)	$1,000	– Mowing and litter/debris removal – Nutrient and pesticide use management – Aeration of soil on the filter strip – Repair of eroded or sparse grass areas	Annual or as needed.
Open channel practices	Dry swales, grassed channels, biofilters	5%–7%	$200–$2,000	– Mowing and litter/debris removal – Stabilization of eroded side slopes and bottom – Nutrient and pesticide use management – Dethatching swale bottom and removal of thatching – Discing or aeration of swale bottom	Annual or as needed
				– Scraping swale bottom, and removal of sediment to restore original cross section and infiltration rate – Seeding or sodding to restore ground cover (use proper erosion and sediment control)	5-year cycle

b. Infiltration practices

Infiltration practices, such as basins, trenches, vegetated swales, and porous pavement, are subject to clogging from sediment, oil, grease, and microbes. Clogging impairs their effectiveness in reducing runoff volume and pollutant loading to downstream waters. When clogging occurs, standing water tends to collect. Seasonal water table fluctuations or ground water mounding can also cause standing water. Facility inspection during dry periods will identify whether standing water is present and what the possible causes are. Inspections should include a site assessment of the contributing drainage area because sediment accumulation in a facility stems from erosion in surrounding areas that can be prevented if the areas are adequately stabilized. The frequency of required maintenance depends on loads from the contributing drainage areas.

If clogging results in pooling, sediment can be removed once the facility has been drained to restore it to its original capacity. If the standing water results from water table conditions, the facility owner should consider converting the site to a permanent pool facility such as a constructed wetland or detention pond. For systems designed with filter fabric to collect sediments, periodic inspections can identify when and where the mesh should be replaced. The filter fabric in infiltration devices adjacent to roads and parking lots in cold climates that are sanded in the winter should be replaced before spring because sediment loads are high during the winter months.

Promotion of a vegetative cover will help to maintain percolation rates, slow runoff velocity, and minimize ground water pollution. Nonvegetated basins require tilling or disking and leveling after sediment removal to maintain aeration and permeability. Vegetated filters that are adjacent to infiltration trenches should be cleared of sediments periodically to prevent sediment loading to the trench.

Regular monitoring of infiltration rates after storm events will indicate when maintenance is required to maintain the system's treatment design capacity.

c. Filtration practices

Filtration practices include media filters (typically sand) and biofilters. Sand filters contain two phases: a sedimentation chamber and a filtration chamber. The sedimentation chamber can be inspected by measuring sediment depth to determine if the deposited sediments are getting deep enough to interfere with the filtration chamber. Different types of sand filters require different levels of maintenance. The Austin sand filter system usually requires maintenance every 5 to 10 years, depending on the stability of soils in the contributing areas, and can be treated like a dry detention facility. The filter component can be raked of fine sediments or skimmed with a shovel to restore permeability. The Washington and Delaware sand filter sedimentation chambers, which maintain a pool of water, should be vacuumed to remove sediment when inspections during filter maintenance identify accumulation to more than ¾ of capacity. Filtration chambers for these systems might need to be cleaned of fine particles as frequently as twice per year to maintain their efficiency and prevent overflows. A flat-bottomed shovel can be used to remove the sediment-laden filter media and roughen surfaces to improve permeability.

Each system should be inspected for vandalism, leaks, cracks, or damage to concrete at least once per year. These problems should be remedied immediately. All materials removed from the systems should be tested to determine if contamination is present and identify how the material should be disposed of (e.g., as clean fill, in a landfill, or as a hazardous waste).

Biofiltration system vegetation should be mowed periodically to maintain an optimum height (between 2 and 6 inches) that maximizes infiltration and minimizes runoff velocity. Special effort should be made to promote native species and exclude invasive species, which can grow too vigorously and reduce treatment capacity. Some replacements are desirable, such as wetland plants that colonize a low-lying biofilter. Inspection and maintenance records should reflect these changes.

Biofiltration facilities should be inspected and maintained at least monthly. Sediment removal is an important and sometimes expensive part of biofilter maintenance. Sediment should be removed when it fills 20 percent of the design depth in any spot or starts to cover vegetation. Efforts should be made to return the system to its original topographic and vegetative condition once the sediment has been removed. Inlets and outlets should be cleared of particles and debris to prevent backups and overflows.

Table 8.3 lists maintenance equipment needed for the tasks described previously, along with purchase and rental costs.

Table 8.3: Typical O&M equipment and material costs (All costs are in 1997 dollars).

Equipment	Purchase	Rent (per day)
Grass Maintenance		
Hand mower	$300–$500	$25–$50
Riding mower	$3,000–$7,000	$75–$150
Tractor mower	$20,000–$30,000	$150–$450
Trimmer/edger	$200–$500	$25–$35
Spreader	$100–$200	$20–$30
Chemical sprayer	$200–$500	$25–$40
Vegetative Cover Maintenance		
Hand saw	$15–$20	$5
Chain saw	$300–$800	$15–$35
Pruning shears	$25–$40	$5
Shrub trimmer	$200–$300	$25–$35
Brush chipper	$2,000–$10,000	$100–$300
Sediment, Debris, and Trash Removal		
Vactor truck	$100,000–$250,000	$700–$1,200
Front-end loader	$60,000–$120,000	$250–$500
Backhoe	$50,000–$100,000	$250–$500
Excavator	>$100,000	$400–$1,000
Grader	>$100,000	$400–$1,000
Transportation		
Van	$18,000–$30,000	$50–$100
Pickup truck	$15,000–$25,000	$50–$100
Dump truck	$40,000–$80,000	$100–$200
Light-duty trailer	$3,000–$6,000	$50–$100
Heavy-duty trailer	$10,000–$20,000	$100–$250
Miscellaneous		
Shovel	$15	$5
Rake	$15	$5
Pick	$20	$5
Wheelbarrow	$100–$250	$15–$25
Portable compressor	$800–$2,000	$50–$150
Portable generator	$750–$2,000	$50–$150
Concrete mixer	$750–$1,500	$50–$100
Welding equipment	$750–$2,000	$50–$100

Table 8.3 (continued).

Equipment	Purchase	Rent (per day)
Materials		
Topsoil	$35–$50/cubic yard	
Fill Soil	$15–$30/cubic yard	
Grass seed	$5–$10/pound	
Soil amenities	$0.10–$0.25/square foot	
Chemicals	$10–$30/gallon	
Mulch	$25–$40/cubic yard	
Dry mortar mix	$5/50-pound bag	
Concrete delivered	$60–$100/cubic yard	
Machine/motor lubricants	$5–$10/gallon	
Paint	$20–$40/gallon	
Paint Remover	$10–$20/gallon	

Source: WMI, 1997.

Information Resources

Operation, Maintenance, and Management of Stormwater Management Systems (WMI, 1997) presents a comprehensive review of the technical, educational, and institutional elements needed to ensure that storm water management systems are designed, built, maintained, and operated properly during and after their construction. The book includes fact sheets that summarize the operation, maintenance, and management needs and obligations, as well as construction recommendations, for 13 common storm water treatment BMPs. Other chapters review planning and design considerations, programmatic and regulatory aspects, considerations for facility owners, construction inspection, inspection and maintenance after construction, costs and financing, and disposal of storm water sediments. Forms for inspecting BMPs during construction and to determine maintenance needs afterwards are included in the book and in a separate supplement and are available at *www.epa.gov/owow/nps/wmi/inspform.pdf*.

The South Carolina Department of Health and Environmental Control (2000) published *A Citizen's Guide to Stormwater Pond Maintenance in South Carolina*, which is available for download in PDF format at *www.scdhec.net/eqc/ocrm/pubs/ponds.pdf*. The booklet is intended as a guide for homeowners' associations and others responsible for the proper maintenance of storm water ponds. Photos and descriptions of nuisance aquatic plant species are also presented in the guide to aid in identifying these species and removing them from ponds. Copies of the guide are available from Ward Reynolds at 843-747-4323.

The Stormwater Manager's Resource Center (CWP, no date) has sample O&M checklists available for download from their web site (*www.stormwatercenter.net*). When at the site's homepage, click on "Manual Builder" and choose "Construction and Maintenance Checklists" from the pull-down list. There are checklists for the following practices: ponds, infiltration trenches, infiltration basins, bioretention facilities, sand filters, and open channel practices.

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